

A MONOGRAPH OF THE GENERA BLOOMERIA AND MULLA (LILIACEAE)

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This paper treats the two small liliaceous genera, *Bloomeria* and *Muilla*. *Bloomeria* has two species, ranging from San Benito County, California, to northern Baja California, Mexico, while *Muilla* has three ranging from Glenn County, California, to northern Baja California and east to western Nevada. Keys have been included to separate closely related genera as well as the species and varieties of *Bloomeria* and *Muilla*. An exclamation point (!) indicates that the type, isotype or photograph of the type has been examined. Where type specimens have not been seen, species determinations have been based on original descriptions aided by available photographs.

This study is based on herbarium material and on fresh material collected by the author. In the study of herbarium specimens measurements of scapes, leaves, and pedicels were made on dry material, but the floral parts were first boiled in water.

The author wishes to thank the following people: Dr. Louis C. Wheeler for suggestions and supervision; Mr. John Thomas Howell, California Academy of Sciences, for information regarding type material; Dr. Albert L. Delisle, Curator of the Greene-Nieuwland Herbarium, University of Notre Dame, for pertinent information concerning Greene's type species; Mr. John McB. Robertson for aid in collecting specimens; the curators of various herbaria and Mr. Robert L. Dressler for loan of specimens.

In the citation of specimens, herbaria are referred to by the abbreviations listed in Lanjouw and Stafleu (Index Herbariorum, part 1, 1952). Abbreviations for herbaria not included in this list, are: Herbarium of Robert L. Dressler, University of Southern California, Department of Botany (D); Herbarium of the author (IN); The Vegetation Type Map Herbarium of the California Forest and Range Experiment Station, University of California, Berkeley (VTM).

KEY TO BLOOMERIA, MULLA, AND CLOSELY RELATED GENERA

Pedicels jointed at the summit.

Perianth-segments united into a distinct tube.....*Brodiaea*

Perianth-segments distinct to the base.....*Bloomeria*

Pedicels not jointed at the summit.

Plants arising from fibrous-coated corms, herbage not having the odor of onions; perianth-segments 2 or 3 nerved.....*Muilla*

Plants arising from tunicated bulbs or corms, herbage having the odor of onions; perianth-segments 1 nerved.....*Allium*

BLOOMERIA Kell. Proc. Calif. Acad. 2:11. 1859.

Stem scapose, arising from a fibrous-coated corm; leaves, basal, linear, and carinate; flowers numerous, yellow, in a loose

terminal umbel; pedicels subtended by numerous membranous bracts. Perianth-segments 6, distinct, nearly equal, oblong-linear, subrotate at anthesis, persistent. Stamens 6, fertile, a little shorter than and inserted on the base of the perianth-segments; filaments margined at the base by wing-like or cup-shaped appendages; anthers versatile, attached near the base. Style 1, persistent, splitting with the subglobose, loculicidal capsule. Seeds 1 to several per locule, black, subovoid, angular and wrinkled. (H. G. Bloomer, early California botanist and one time Botanical Curator of the California Academy of Sciences, San Francisco.) Type Species: *Bloomeria aurea*.

KEY TO SPECIES AND VARIETIES OF BLOOMERIA

- Filament margined by an oblong, entire, smooth appendage (fig. 2, 4); style shorter than the ovary; leaves several. San Diego County
1. *B. Clevelandii*.
- Filament with a basal papillose nectariferous cup (appendage); style longer than the ovary; leaf solitary, rarely two.
Nectariferous cup of the filament shallowly bicuspidate at apex (fig. 2, A)..... 2a. *B. crocea* var. *crocea*.
Nectariferous cup ending in 2 awn-like cusps.
Cusps not attenuate, 1 to 2 mm. long, less than half as long as the filament (fig. 2, B)..... 2b. *B. crocea* var. *aurea*.
Cusps attenuate, 3 to 3.5 mm. long, about half as long as the filament (fig. 2, C)..... 2c. *B. crocea* var. *montana*.

1. BLOOMERIA CLEVELANDII S. Wats. Proc. Am. Acad. 20:376. 1885. Type: mesas near San Diego, California in 1884, *Cleveland* (GH!). The type is representative of the species.

Scape 12.5–25.5 cm. long, scabrous; pedicels 2.5–4 cm. long; flowers 10 to 20; perianth-segments 6–10 mm. long, yellow with a green central stripe; filaments 3–5 mm. long; anthers 1.5–2.5 mm. long, pale yellow or white; appendages of the filaments smooth, oblong, entire, obtuse at the apex.

Distribution. *Bloomeria Clevelandii* occurs only in San Diego County, California (fig. 1, B).

Material examined. San Diego County: south side Montezuma Road, south of Alvarado tract, San Diego, *Ingram 102* (IN, LAS); Camp Kearney Mesa, *Purer 6534* (LAS); San Diego, *Cleveland* (UC); San Diego and vicinity, *Woodcock 80* (UC); San Diego, *Greene* in 1885 (UC); San Diego, *Orcutt* in 1884 (UC); Linda Vista on Kearney Mesa, *Gander 8316* (UC); Rancho Santa Fe, *Gander 8308* (UC).

The smooth, oblong stamen appendage of *B. Clevelandii* clearly separates it from *B. crocea* whose filaments have a basal papillose, nectariferous cup (fig. 2). Furthermore, it often has two or three scapes per corm, whereas *B. crocea* has only one.

2. BLOOMERIA CROCEA (Torr.) Cov. Contr. U.S. Nat. Herb. 4:203. 1893.

Scape 20–70 cm. long (average 40), minutely scabrous; leaf solitary, about as long as the scape, 3–15 mm. wide; pedicels

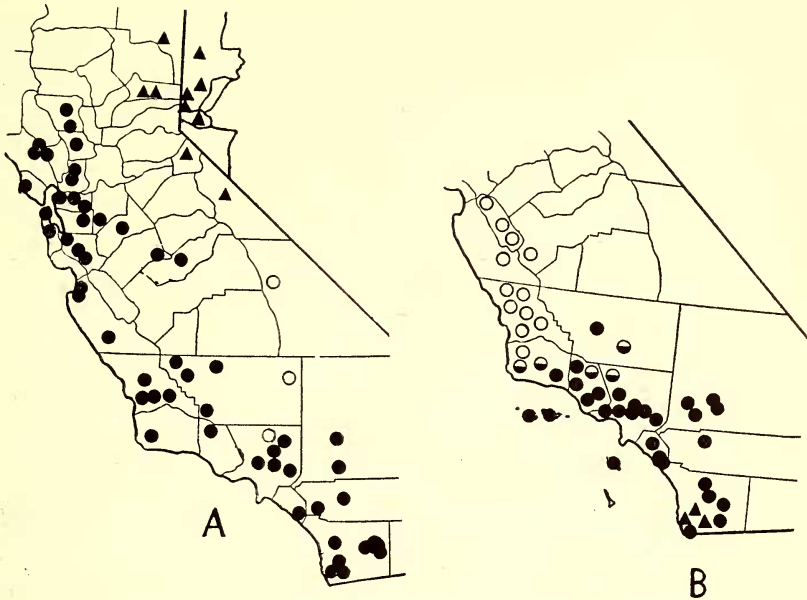


FIG. 1. A. Range of *Muilla* in California and Nevada. *M. maritima*, dots; *M. coronata*, circles; *M. transmontana*, triangles. B. Range of *Bloomeria* in California. *B. crocea* var. *crocea*, dots; *B. crocea* var. *aurea*, circles; *B. crocea* var. *montana*, half-filled circles; *B. Clevelandii*, triangles.

5–65 mm. long (average 30); flowers 5 to 75 (average 30 to 45); perianth-segments 5–13 mm. long (average 8), yellow with a brown mid-vein; filaments 3–10 mm. long; anthers 1.5–3 mm. long; appendages of the filaments papillose; style longer than the ovary.

2a. *BLOOMERIA CROCEA* (Torr.) Cov. var. *crocea*.

Allium croceum Torr. in Emory, U.S. & Mex. Bound. Surv. 2 (1):218. 1859¹. Type: summit of mountains east of San Diego, California, in 1859, Parry (NY!). The type is an average specimen except for fewer flowers. *B. crocea* Cov., Contr. U.S. Nat. Herb. 4:203. 1893.

Perianth-segments yellow-orange, 5–12 mm. long; stamen appendages bicuspidate at the apex.

Distribution. This variety ranges from western Kern County, Santa Barbara County, and the Channel Islands, California, to northern Baja California (fig. 2, B).

Representative specimens examined. CALIFORNIA. Santa Barbara County: Santa Rosa Island, Youngberg in 1938 (POM); Pelican Bay, Santa Cruz Island, Clokey 4829 (UC); Santa

¹According to I. M. Johnston (Jour. Arn. Arb. 24:237. 1943) volume two was issued in late April or May, 1859.

Barbara, *Carlson* in 1918 (CAS). Kern County: mesas near Bakersfield, *Osborn* in 1930 (LAM). Ventura County: Sulfur Mountain, *Epling & Anderson* in 1931 (LA); Saticoy, *Eastwood 5059* (CAS); Happy Camp Canyon, Piru quadrangle, *Gifford 109* (VTM). Los Angeles County: Puente Hills near Pomona, *Ingram 104* (IN, LAS); Santa Catalina Island, *K. Brandegee* in 1916 (UC); Mandeville Canyon, *Clokey & Templeton 4543* (UC); Pico Canyon *Johnstone* in 1931 (LAS); near University of California, *Wheeler 672* (LA); Franks Canyon north of Beverly Hills, *Templeton 1069* (LAM). San Bernardino County: Mt. Horne, San Bernardino Mountains, *Lemmon* in 1888 (UC); Mohave River, *Parry & Lemmon 392* (UC); Seven Oaks, *Davidson 2243* (LAM); Mentone, *Lewis* in 1936 (LA). Riverside County: near Highgrove, *Edge* in 1934 (LAS). Orange County: Laguna Beach, *Johnson 4419* (LA); north of Orange, *Johnson 4023* (LA); San Juan Canyon, *Cooper 1343* (LA). San Diego County: Palomar Mountain, *Cooper 1477* (LA); mesas, Mountain Springs Grade, *Orcutt 155* (UC); Black Canyon, Otay Ranch, *Gander 7476* (UC); Rancho Santa Fe, *Gander 8307* (UC) Cuyamaca Lake, *Higgins 3158* (UC); Escondido, *Meyer 742* (UC). BAJA CALIFORNIA. Aliso, *T. S. Brandegee* in 1893 (UC).

The perianth-segments are nearly always striped by two dark parallel lines. The width and darkness of the lines vary, and they are absent in some flowers. The color of the anthers ranges from green to blue-green and even purple.

2b. *BLOOMERIA CROCEA* var. *aurea* (Kell.) comb. nov.

Bloomeria aurea Kell., Proc. Calif. Acad. 2:11. July, 1859; *Hesperian* 3:437. December, 1859. Type locality: New Idria, California. Inasmuch as no type specimen is known to exist (J. T. Howell, written communication, 18 January 1951), the interpretation of this species is based on Kellogg's description and the diagram in *Hesperian*. *Nothoscordum aureum* Hook. f., Bot. Mag. 27: pl. 5896. 1871.

Flowers 5 to 50; perianth-segments yellow, 11-12 mm. long; cusps of the filament appendages linear, 1-1.5 mm. long.

Distribution. This variety occurs in the Coast Ranges from San Benito County to northern Santa Barbara County, California (fig. 1, B).

Material examined. San Benito County: Pacheco Pass, near Camp 77, *Brewer 1291* (CAS, UC); Pinnacles, *Epling 8415* (LA); Pinnacles, *Rodder* in 1926 (CAS). Monterey County: Mustang Grade, *Eastwood & Howell 5807* (CAS). Fresno County: San Lucas Road in Alcalde Canyon, 7.5 miles west of Coalinga, *Ferris & Bacigalupi 10355* (CAS, UC). San Luis Obispo County: Cholame, *Eastwood 13895* (CAS); near Morro, *Barber* in 1899 (UC); Paso Robles, *Dudley* in 1927 (CAS); Freeman Canyon, Paso Robles quadrangle, *Lee 949* (VTM); ¼ mile

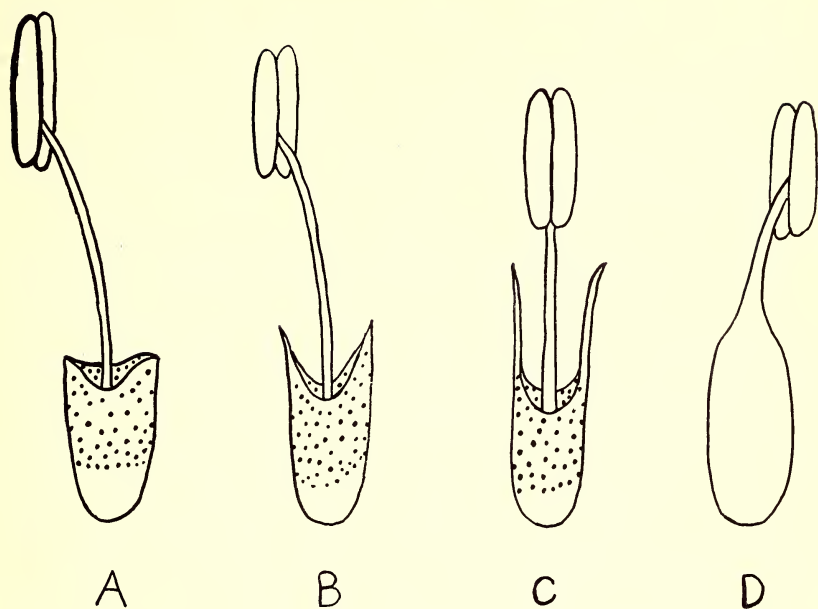


FIG. 2. Diagrams of the stamens of *Bloomeria* (ca. $\times 5$). A, *B. crocea* var. *crocea*; B, *B. crocea* var. *aurea*; C, *B. crocea* var. *montana*; D, *B. Clevelandii*.

south of Canmatti Ranch, Pozo quadrangle, *Hendrix 219* (VTM). Santa Barbara County: Suey Creek, near Santa Maria, *Eastwood 385* (CAS).

Variety *aurea* differs from variety *crocea* in its filament appendages. A drawing in Hesperian on p. 438 clarifies what Kellogg described as appendages resembling "awned achenia of many composites" in var. *aurea*. Torrey described the filaments of *B. crocea* var. *crocea* as "filiform, with an oblong, adnate tooth on each side of the base." Diagrams of the stamens (fig. 2) showing the relationships between the varieties of *B. crocea* clarify the statements of Kellogg and Torrey.

2c. *BLOOMERIA CROCEA* var. **montana** (Greene) comb. nov.

Bloomeria montana Greene, Bull. Calif. Acad. 1:281. 1885. Type: mountains of Kern County, California, near Tehachapi in 1884, *Curran* (CAS 127!; isotype, UC!). The type is representative of the species.

Perianth-segments yellow, 11-13 mm. long; cusps of the filament appendages 3-3.5 mm. long, attenuate, about half as long as the filaments.

Distribution. This variety is found in the Tehachapi Mountains and in the southern Coast Ranges, California (fig. 1, B).

Material examined. Kern County: north of Tehachapi, *Ingram & Dressler 913* (IN, D); near Tehachapi, *Davidson 1904* (LAM). Santa Barbara County: head of Santa Agueda Creek, Lompoc quadrangle, *Axelrod 494* (VTM); trail to Manzana Creek, Zaca Lake Forest Reserve, *Eastwood 616* (CAS). Ventura County: Mt. Pinos, *Hart 21* (CAS); Lockwood Valley, Mt. Pinos, *Hall 6443* (CAS). Los Angeles County: Ridge Route, *Winblad* in 1937 (CAS).

MUILLA S. Wats. Proc. Am. Acad. 14:235. 1879.

Stem scapose, arising from a fibrous-coated corm; leaves basal, usually few, subterete to terete. Flowers several, white or greenish-white, in an umbel subtended by several scarious bracts. Pedicels not jointed at the summit, subtended by several membranous bracteoles. Perianth of 6 parts, subrotate at anthesis, distinct almost to the base with a dark 2 or 3-nerved midvein. Stamens 6, fertile, inserted at the base of the perianth-segments; filaments filiform or petaloid; anthers versatile. Style clavate, persistent, and at length splitting with the globose, slightly lobed, loculicidal capsule. Seeds 1 to several per locule, compressed, angled and black. (Anagram of *Allium*.) Type species: *Muilla maritima*.

KEY TO SPECIES OF MUILLA

Filaments petaloid 1. *M. coronata*.
 Filaments not petaloid; filiform above, dilated, free or united at the base.

Flowers white, filaments dilated, united basally to form a shallow cup around the ovary 2. *M. transmontana*.

Flowers greenish-white, filaments dilated, not united basally 3. *M. maritima*.

1. MUILLA CORONATA Greene, Pittonia 1:165. 1888. Type: Lancaster, Mohave Desert, California, late in March, 1888. *Parry* (ND not seen; photograph IN!, LAS!). The interpretation of the species is based on the description and the photograph of the specimen labeled "*M. coronata* Greene, Pitt. 1:165" (in Greene's hand fide Dr. Albert Delisle). The label reads "April" instead of "late in March," but this specimen is presumably the type as it is the only Parry collection of this species in the Herbarium Greeneanum.

Scape 8.5–15 cm. long; leaves 2 or 3, subterete, about twice as long as the scape; pedicels 3 to 8, 5–14 mm. long; perianth greenish-white with very wide, green midveins; filaments petaloid, their margins overlapping but not joined, retuse at the summit; anthers yellow, attached by the middle at the notch.

Distribution. *Muilla coronata* is found only on the Mohave Desert, California (fig. 1, A), and is not common.

Material examined. Inyo County: 1 mile west of Independence, *Kern 488* (CAS). Kern County: Iron Canyon, El Paso Mt., north rim of Mohave Desert, *Weston* in 1926 (CAS). "Mohave Desert," *Sherwood* in 1932 (LAS).

This species is easily distinguished by its unique petaloid filaments.

2. *MUILLA TRANSMONTANA* Greene, Pittonia 1:73. 1887. Type: Reno, Nevada, *Amy Pease*. [This specimen has not been located.] The interpretation of the species has been based on geographic location, the description by Greene, and on a photograph of a specimen labeled "*M. transmontana*, Pittonia 1:73" in Greene's hand. This specimen was collected at Reno, Nevada, May 1888, by C. F. Sonne and is located in the Herbarium Greeneanum at the University of Notre Dame. In a letter of April 22, 1951, Dr. Albert Delisle states that the handwriting on this specimen is Greene's.

Scape 10.5–50 cm. long (average 21), usually fusiform-enlarged at the ground; leaves 3 to 5, as long or longer than the scape; pedicels 10 to 25 (average 15), 2 cm. long; perianth-segments white, 6–8 mm. long, 2 mm. wide, 2-nerved; filaments ca. 3 mm. long, widely dilated at the base, united at their bases forming a cup around the ovary; anthers 1.5–2 mm. long, yellow.

Distribution. This species is found in western Nevada and in the adjoining counties of California (fig. 1, A).

Material examined. CALIFORNIA. Lassen County: south of Janesville, *Ripley & Barneby* 5953 (CAS). Alpine County: Hope Valley, *Eastwood & Howell* 8477 (CAS, POM). Sierra County: about 3½ miles east of Loyalton, *Stebbins & Jenkins* 2131 (UC). Mono County: Twin Lake Road, 11:5 miles west of Bridgeport, *Cantelow* in 1941 (CAS). NEVADA. Ormsby County: King's Canyon, *C. F. Baker* 933 (POM); Carson City, *M. E. Jones* in 1897 (POM). Washoe County: 8 miles north of Reno along road to Pyramid Lake, *Mathias* 1218 (UC) 7 miles northwest of Pöeville, *Tillotson* 83 (VTM); Verdi, *Sonne* in 1889 (UC).

Muilla transmontana differs from *M. maritima* in having filaments which are much wider, and basally united to form a shallow basal cup around the ovary. The perianth-segments are not quite distinct to the base, but form a short tube. The fusiform enlargement of the scape is not evident in all of the dry specimens.

3. *MUILLA MARITIMA* (Torr.) S. Wats., Proc. Am. Acad. 14:235. 1879.

Hesperoscordium? maritimum Torr. in Whipple, Rep. Expl. & Surv. Miss R. to Pacific Ocean 4 (5):148. 1857². Type: seashore, Punta de los Reyes, California, *Bigelow* (NY!). This is an average specimen. *Allium maritimum* Benth., Pl. Hartw. 339. 1857. *Milla maritima* S. Wats. in King, U.S. Geol. Expl. 40th Par. 5:354. 1871. *Bloomeria maritima* Macbride, Contr. Gray Herb. ser. 2, 56:8. 1918.

²Date according to I. M. Johnston (Jour. Arn. Arb. 24:242. 1943).

Muilla serotina Greene, *Erythea* 1:152. 1893. Type: near Los Angeles, California, *Davidson* 2052 (UC 119707!). *Bloomeria maritima* var. *serotina* Macbride, *Contr. Gray Herb. ser. 2*, 56:8. 1918.

Muilla tenuis Congdon, *Zoe* 5:35. 1901. Type: Raymond, Madera County, California, *Congdon* in 1900 (UC 119714!).

Scape 8–38 cm. long; leaves 3 to 10, almost terete, retrorsely scabrous, shorter or longer than the scape; pedicels 1.5–5 cm. long, unequal; flowers 5 to 35 per umbel; perianth-segments 3–5 mm. long, 1.5–2.5 mm. wide; filaments filiform, 1.5–2.5 mm. long, their bases dilated, not united; anthers 1–2 mm. long.

Distribution. *Muilla maritima* occurs in the mountains and lowlands from Glenn County, California, southward to northern Baja California (fig. 1, A).

Material examined: CALIFORNIA. Glenn County: 4 miles south of Willows, *Heller* 15363 (UC); Norman, *Hoover* 3234 (UC). Colusa County: about 20 miles north of Williams, *Meyer* 1346 (UC). Lake County: near Calistoga Geyser, *Baker* 3565b (UC). Napa County: Myrtle Dale Hot Springs near Calistoga, *Howell* 1760 (CAS); Geysers south of Calistoga, *Keck* 1096 (POM). Sonoma County: opposite Myrtle Dale Geyser, 1½ miles north of Calistoga, *Bacigalupi* 1252 (POM). Marin County: Pt. Reyes Peninsula, *Howell* 21756 (CAS). Solano County: Little Oak Ranch, *Jepson* in 1885 (UC). Contra Costa County: Stege, *Davy* 6527 (UC); Byron Springs, *Eastwood* 3788 (CAS). San Joaquin County: Castle Rock, Corral Hollow, *Constance & Beetle* 2526 (CAS, POM, UC). Alameda County: Livermore Valley, *Howell* 13740 (CAS). San Francisco County: Twin Peaks, *Hoover* 2813 (UC); San Francisco, *Greene* in 1888 (UC). San Mateo County: Crystal Springs Lake, *Baker* 423 (POM, UC). Santa Clara County: 4 miles east of Monument Peak, *Wilson* 569 (UC); San Martin, *Chandler* 863 (UC). Stanislaus County: Carpenter Road near San Joaquin River, *Hoover* 4331 (UC). Merced County: near Le Grand, *Hoover* 731 (UC); 2.9 miles southwest of Merced, *Hoover* 812 (UC). Madera County: Raymond, *Eastwood* 12578 (CAS). Monterey County: Del Monte, *Elmer* 3550 (CAS, POM, UC); Bardino, *Elmer* 4601 (CAS, POM, UC). San Luis Obispo County: Nipomo Mesa, *Eastwood & Howell* 3886A (CAS); Pismo Creek, 3 miles from Pismo, *Munz* 9259 (POM, UC). Kern County: Maricopa Grade, *Eastwood & Howell* 4050 (CAS); between Lost Hills and Semitropic, *Hoover* 1805 (UC). Santa Barbara County: 5 miles west of Buellton, *Munz* 10305 (POM, UC). Ventura County: Mt. Pinos, *Munz* 7038 (POM). Los Angeles County: Pasadena, *Grant* 803 (CAS, POM, UC); San Dimas Canyon, *Clokey & Anderson* 5855 (UC); Claremont, *Baker* 4759 (CAS, POM); 2½ miles south southeast of Neenach, *Gifford* 206 (VTM); San Gabriel Canyon, *Eastwood* 8968 (CAS); 4 miles west of Vincent, *Dressler* 710 (D). San Bernardino County: San Antonio

Canyon, San Gabriel Mountains, *Ingram 105* (LAS); 8 miles east of Victorville, *Jaeger* in 1932 (POM); Waterman Canyon, San Bernardino Mountains, *Parish 11412* (UC). Riverside County: 7 miles east of Hemet, *Dressler 816* (D); 2 miles south of Lake Elsinore, *Peirson 2942* (POM, UC); Hemet Valley, San Jacinto Mountains, *Munz & Johnston 5535* (POM). Orange County: Capistrano, *Abrams 3263* (POM). San Diego County: 24 miles northwest of Carrizo, *Dressler 540* (D); mesas, East San Diego, *Ingram 103* (IN, LAS); San Felipe, *T. S. Brandegee* in 1894 (UC); San Diego, *Brandegee 3382* (POM, UC); Escondido, *Meyer 113* (UC). BAJA CALIFORNIA. Near San Antonio del Mar, *Wiggins 4540* (POM).

The color of the anthers in *M. maritima* varies from blue to blue-green, green and even purple. This species has a very diverse habit. Over most of its range the plants are typically small, but southward in Los Angeles and San Bernardino counties they become considerably larger. In most floras, the smaller phase has been known as *M. maritima*, the larger as *M. serotina*. Most keys separate them by stating that *M. serotina* differs from *M. maritima* in having "pit-like glands" present on its inner perianth-segments, and anthers that measure not over 0.75 mm. I have not been able to locate glands on any of the plants. The only difference I can find is difference in size. Both phases may have as many as two or three scapes per plant, but the southern phase is much larger, has few leaves and more flowers. I find no way of distinguishing these plants as separate species, nor any basis for designating the southern phase as a variety of *M. maritima*. *Muilla tenuis*, another phase found in Madera and San Diego counties differs from the typical in its slender habit.

DOUBTFUL SPECIES

BLOOMERIA GRACILIS Borzi, Boll. Ort. Palermo 1:19. 1897.

There is no statement as to the type locality for this plant. Being later, it cannot replace any of the specific names here maintained. From the description given by Borzi, it appears that it is a small plant of *B. crocea* var. *crocea*.

EXCLUDED SPECIES

Brodiaea Purpusii (T. S. Brandegee) comb. nov.

Muilla Purpusii T. S. Brandegee, Univ. Calif. Publ. Bot. 4:177. 1911. Type: Sierra de la Paila, Coahuila, Mexico, *Purpus 4959* (UC 148555!; isotypes, GH!, US!). *Bloomeria Purpusii* Macbride, Contr. Gray Herb. ser. 2, 56:8. 1918.

This taxon cannot be a *Muilla* as it has jointed pedicels. It cannot be a *Bloomeria* as it has its perianth-segments joined in a short tube. The nonstipitate ovary is similar to that found in *Brodiaea*. On these bases, I am placing this entity in the genus *Brodiaea*.

Distribution. Known only from the type collection.

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